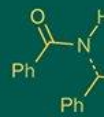


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Genetic association among yield and its component traits in ash gourd (*Benincasa hispida* (Thunb.) Cogn.) genotypes

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Abstract

The present investigation was conducted during the rabi season of 2025 at the Experimental Block, Agricultural and Horticultural Research Station, Thirthahalli, to study the association among yield and its component traits in ash gourd (*Benincasa hispida* (Thunb.) Cogn.). The experiment was laid out in a Randomized Complete Block Design (RCBD) with 26 genotypes and three replications. Observations were recorded on growth, flowering, fruit and yield traits and correlation analysis was performed to estimate the relationship among the characters. Genotypic correlations were generally higher than the corresponding phenotypic correlations, indicating that the observed associations were largely governed by genetic factors. Fruit yield per plant exhibited significant positive correlations with fruit diameter, average fruit weight, number of fruits per vine, fruit cavity width, fruit thickness, fruit length and number of primary branches at both genotypic and phenotypic levels. In contrast, total soluble solids, days to first fruit harvest and days to last fruit harvest showed negative associations with fruit yield. The study revealed that fruit diameter, average fruit weight, number of fruits per vine, fruit thickness, fruit length and number of primary branches are the major yield-contributing traits and can serve as reliable selection criteria for developing high-yielding ash gourd genotypes.

Keywords: Ash gourd, correlation analysis, fruit yield, genotypic association, phenotypic correlation

Introduction

Ash gourd [*Benincasa hispida* (Thunb.) Cogn.] is an important cucurbitaceous vegetable crop cultivated extensively in tropical and subtropical regions for its tender as well as mature fruits. The crop is highly valued because of its excellent keeping quality, long shelf life under ambient conditions, ease of transportation and wide adaptability to diverse agro-climatic conditions. Ash gourd fruits are rich in moisture, dietary fibre, vitamins, minerals and several bioactive compounds that possess antioxidant, anti-inflammatory, antibacterial, antidiabetic and neuroprotective properties, making the crop an important functional food with considerable medicinal value. In India, the fruits are consumed as fresh vegetables and are extensively utilized in the preparation of processed products such as petha, candies and preserves. (Ananda *et al.*, 2022) ^[2], (Sureja *et al.*, 2006) ^[14] (Pradhan *et al.*, 2020) ^[11] and (Bairwa *et al.*, 2017) ^[4].

Despite its nutritional, medicinal and commercial importance, ash gourd remains an underexploited crop and limited emphasis has been placed on the improvement of yield and other economically important horticultural traits through systematic breeding programmes. Fruit yield in ash gourd is a complex quantitative trait controlled by several interrelated growth, flowering and fruit characters and is greatly influenced by environmental factors. Therefore, understanding the nature and magnitude of association among these traits is essential for formulating effective selection strategies in crop improvement. Correlation analysis provides information on the relationship among yield and its component traits, whereas path coefficient analysis partitions the correlation into direct and indirect effects, thereby identifying the traits that contribute most effectively to fruit yield.

Such information enables plant breeders to select superior genotypes based on key yield-contributing characters and enhances the efficiency of selection in breeding programmes. (Rai *et al.*, 2025) ^[13] and (Yadav and Kumar, 2010) ^[18]. Therefore, the present investigation was undertaken to study the association among yield and its component traits through correlation and path coefficient analyses to identify the most important characters influencing fruit yield in ash gourd.

Materials and Methods

The present study was conducted during the *rabi* season of 2025 at the Experimental Block, Agricultural and Horticultural Research Station, Thirthahalli. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 26 treatments and three replications. The crop was planted on ridges and furrows at a spacing of 2.0 m × 1.0 m. All the recommended package of practices was uniformly followed throughout the crop growth period. The recorded data were subjected to statistical analysis following the procedures for RCBD. Three plants were selected randomly from each genotype to record observation on growth, flowering and yield parameters. Correlation coefficients were estimated according to the method of to determine the association among yield and its component traits. Al-Jibourie *et al.* (1958) ^[1].

Results and Discussion

Phenotypic Correlation Analysis

The phenotypic correlation analysis revealed significant associations among the studied traits, although the magnitude of correlations was generally lower than the corresponding genotypic correlations, indicating the influence of environmental factors on trait expression. Fruit yield per plant (FYPP) exhibited a highly significant and positive correlation with fruit yield per hectare (FYPH) (0.99). It also showed significant positive correlations with fruit diameter (FD) (0.626), average fruit weight (AFW) (0.605), number of fruits per vine (NFPV) (0.549), fruit cavity width (FCW) (0.452), fruit thickness (FT) (0.387), number of primary branches (NPB) (0.358), leaf area (LA) (0.319), fruit length (FL) (0.316), days to first female flowering (DFFF) (0.284), sex ratio (SR) (0.289) and days to fruit maturity (DFMF) (0.249). These positive associations suggest that increased fruit size, fruit weight, fruit number and vegetative vigour contribute directly to higher fruit yield by enhancing photosynthetic efficiency

and sink strength. Conversely, total soluble solids (TSS) (-0.283), days to first fruit harvest (DFFH) (-0.082) and days to last fruit harvest (DLFH) (-0.112) exhibited negative correlations with fruit yield per plant, indicating a possible trade-off between yield and quality traits, while earlier harvesting genotypes tended to be more productive shown in (Table 1). Overall, the results indicate that fruit diameter, average fruit weight, number of fruits per vine, fruit thickness, fruit length and number of primary branches are important selection criteria for improving fruit yield in ash gourd similar readings was observed in Latif *et al.* (2008) ^[9], Yadav *et al.* (2010) ^[18], Nithinkumar *et al.* (2022) ^[10], Ananda *et al.* (2023) ^[3] and Thakur *et al.*, 2024 ^[16].

Genotypic Correlation Analysis

The genotypic correlation analysis revealed stronger associations among the studied traits than the corresponding phenotypic correlations, indicating that the observed relationships were predominantly governed by genetic factors with relatively less environmental influence. Fruit yield per plant (FYPP) exhibited a highly significant and positive correlation with fruit yield per hectare (FYPH) (0.99). It also showed significant positive correlations with fruit diameter (FD) (0.710), average fruit weight (AFW) (0.589), number of fruits per vine (NFPV) (0.515), fruit cavity width (FCW) (0.496), fruit thickness (FT) (0.419), number of primary branches (NPB) (0.395), fruit length (FL) (0.362), days to fruit maturity (DFMF) (0.314) and fruit cavity length (FCL) (0.224). These positive associations indicate that improvement in fruit size, fruit weight, fruit number and branching directly contributes to higher fruit yield by enhancing sink capacity and overall fruit production. Conversely, total soluble solids (TSS) (-0.315), days to first fruit harvest (DFFH) (-0.151) and days to last fruit harvest (DLFH) (-0.100) exhibited negative correlations with fruit yield per plant, suggesting a possible trade-off between yield and quality traits and indicating that earlier harvesting genotypes tend to be more productive. Overall, the results suggest that fruit diameter, average fruit weight, number of fruits per vine, fruit thickness, fruit length and number of primary branches are reliable selection criteria for improving fruit yield in ash gourd breeding programmes represented in (Table 2) the similar results were also observed by Tak *et al.* (2019) ^[15], Bhैया *et al.* (2020) ^[5], Bharti and Madan (2020) ^[6], Vijayakumar *et al.* (2020) ^[18], Chauhan *et al.* (2023) ^[7], Hembron *et al.* (2025) ^[8] and Pramod *et al.* (2025) ^[12].

Table 1: Phenotypic correlation coefficients among growth, flowering, yield and quality parameters in ash gourd genotypes

Trait	VL90	NPB	LA	DFFF	NNFFF	D50F	NNFMF	DFMF	SR	FL	FD	AFW	NFPV	FYPH	DFFH	DLFH	FT	TSW	NSPF	FCL	FCW	TSS	FYPP
VL90	1.000	0.290**	0.130	0.701**	0.333**	0.741**	0.549**	0.396**	0.337**	0.093	0.043	0.159	0.371**	0.229*	0.126	0.040	-0.002	0.111	-0.157	0.134	-0.028	-0.051	0.229*
NPB		1.000	0.032	0.251*	0.317**	0.278*	0.166	0.413**	0.243*	0.235*	0.365**	0.261*	0.256*	0.358**	0.095	-0.003	0.205	0.064	0.092	0.158	0.326**	0.014	0.358**
LA			1.000	0.195	0.243*	0.237*	0.037	-0.055	0.353**	0.324**	0.198	0.462**	-0.025	0.319**	-0.016	-0.058	0.333**	-0.254*	0.005	0.291**	0.054	-0.228*	0.319**
DFFF				1.000	0.168	0.978**	0.563**	0.375**	0.546**	-0.042	0.176	0.191	0.392**	0.284*	0.368**	0.236*	-0.103	-0.092	0.182	0.076	0.246*	-0.285*	0.284*
NNFFF					1.000	0.189	0.618**	0.634**	0.006	-0.056	0.163	0.078	0.139	0.090	0.106	0.024	0.260*	-0.169	0.176	-0.094	-0.007	-0.037	0.091
D50F						1.000	0.539**	0.377**	0.565**	0.028	0.134	0.209	0.351**	0.244*	0.295**	0.174	-0.052	-0.066	0.176	0.099	0.177	-0.242*	0.244*
NNFMF							1.000	0.770**	0.177	-0.330**	0.116	0.026	0.483**	0.168	0.188	0.187	-0.071	-0.069	0.209	-0.200	0.101	-0.227*	0.168
DFMF								1.000	0.059	-0.019	0.346**	0.105	0.442**	0.249*	0.095	0.032	0.076	0.085	0.274*	0.002	0.284*	-0.131	0.249*
SR									1.000	0.267*	0.373**	0.471**	0.374**	0.289*	0.278*	0.191	0.208	0.109	0.005	0.328**	0.415**	-0.200	0.289*
FL										1.000	0.384**	0.483**	-0.007	0.315**	-0.154	-0.256*	0.617**	0.356**	-0.173	0.777**	0.108	0.043	0.316**
FD											1.000	0.840**	0.271*	0.626**	0.092	-0.002	0.631**	0.261*	0.240*	0.224*	0.810**	-0.557**	0.626**
AFW												1.000	0.184	0.605**	-0.072	-0.121	0.691**	0.269*	0.090	0.302**	0.642**	-0.593**	0.605**
NFPV													1.000	0.549**	0.190	0.241*	0.098	0.273*	0.011	0.189	0.346**	-0.141	0.549**
FYPH														1.000	-0.081	-0.112	0.387**	0.189	0.025	0.204	0.452**	-0.283*	0.99.**
DFFH															1.000	0.663**	-0.099	-0.017	0.260*	0.135	0.106	-0.172	-0.082
DLFH																1.000	-0.130	0.005	0.338**	0.040	0.052	-0.177	-0.112
FT																	1.000	0.368**	-0.013	0.360**	0.278*	-0.141	0.387**
TSW																		1.000	-0.138	0.339**	0.033	-0.193	0.190
NSPF																			1.000	-0.159	0.376**	-0.303**	0.025
FCL																				1.000	0.136	0.048	0.204
FCW																					1.000	-0.464**	0.452**
TSS																						1.000	-0.283*

*Significant at 5% **Significant at 1%

VL90: Vine length (cm) at 90 DAT NPB: Number of primary branches LA: Leaf area (cm²) per plant DFFF: Days taken for first female flowering

NNFFF: Node number on which first female flower appears D50F: Days to 50% flowering NNFMF: Node at male flower appear DFMF: Days taken for first female flowering SR: Sex ratio FL: Fruit length (cm) FD: Fruit diameter (cm) AFW: Average fruit weight (kg) NFPV: Number of fruits per vine FYPP: Fruit yield per plant (kg) FYPH: Fruit yield per hectare (tons) DFFH: Days to first fruit harvest DLFH: Days to last fruit harvest FT: Flesh thickness (mm) TSW: Total seed weight per fruit (g) NSPF: Number of seeds per fruit (count) FCL: Fruit cavity length (cm) FCW: Fruit cavity width (cm) TSS: Total soluble solids (°Brix)

Table 2: Genotypic correlation coefficients for growth, flowering, yield and quality parameters in ash gourd genotypes

Trait	VL90	NPB	LA	DFFF	NNFFF	D50F	NNFMF	DFMF	SR	FL	FD	AFW	NFPV	FYPH	DFFH	DLFH	FT	TSW	NSPF	FCL	FCW	TSS	FYPP
VL90	1.000	0.373**	-0.117	0.369**	0.450**	0.467**	0.456**	0.605**	-0.045	0.106	0.024	0.061	0.302**	0.025	0.116	0.175	-0.020	0.130	-0.210	0.164	-0.079	-0.080	0.025
NPB		1.000	0.026	0.440**	0.209	0.496**	0.175	0.251*	0.286*	0.087	0.254*	0.276*	0.270*	0.395**	0.052	0.068	0.124	0.029	0.042	0.028	0.227*	-0.101	0.395**
LA			1.000	-0.160	0.274*	-0.077	-0.086	-0.084	0.218	0.379**	0.221	0.436**	-0.109	0.238*	-0.050	-0.048	0.363**	-0.277*	0.008	0.328**	0.050	-0.252*	0.238*
DFFF				1.000	0.302**	0.922**	0.539**	0.798**	0.164	-0.134	0.299**	0.082	0.380**	0.021	0.671**	0.769**	-0.224*	-0.205	0.347**	0.116	0.423**	-0.568**	0.020
NNFFF					1.000	0.346**	0.702**	0.558**	-0.009	-0.254*	0.023	0.079	0.141	0.096	0.076	0.078	0.189	-0.222	0.134	-0.256*	-0.150	-0.154	0.096
D50F						1.000	0.492**	0.803**	0.207	0.014	0.213	0.116	0.301**	-0.058	0.509**	0.620**	-0.125	-0.156	0.336**	0.163	0.287*	-0.482**	-0.058
NNFMF							1.000	0.97**	-0.022	-0.403**	0.122	-0.037	0.442**	0.062	0.212	0.297**	-0.083	-0.080	0.228*	-0.239*	0.100	-0.257*	0.062
DFMF								1.000	0.048	-0.393**	0.145	0.118	0.548**	0.314**	0.014	0.142	-0.098	0.031	0.238*	-0.286*	0.104	-0.391**	0.314**
SR									1.000	0.336**	0.462**	0.457**	0.304**	0.138	0.343**	0.376**	0.248*	0.118	0.006	0.408**	0.502**	-0.257*	0.138
FL										1.000	0.257*	0.538**	-0.024	0.362**	-0.301**	-0.287*	0.582**	0.348**	-0.263*	0.740**	-0.047	-0.088	0.362**
FD											1.000	0.922**	0.287*	0.710**	0.037	0.075	0.599**	0.242*	0.202	0.097	0.782**	-0.755**	0.710**
AFW												1.000	0.149	0.589**	-0.120	-0.126	0.724**	0.271*	0.092	0.323**	0.685**	-0.633**	0.589**
NFPV													1.000	0.515**	0.208	0.350**	0.096	0.277*	0.010	0.196	0.363**	-0.157	0.515**
FYPH														1.000	-0.151	-0.100	0.419**	0.196	0.028	0.225*	0.496**	-0.315**	0.99**
DFFH															1.000	0.98**	-0.178	-0.043	0.310**	0.109	0.069	-0.261*	-0.151
DLFH																1.000	-0.125	0.028	0.447**	0.116	0.139	-0.210	-0.100
FT																	1.000	0.356**	-0.051	0.299**	0.212	-0.225*	0.419**
TSW																		1.000	-0.155	0.326**	-0.002	-0.231*	0.196
NSPF																			1.000	-0.226*	0.352**	-0.360**	0.028
FCL																				1.000	0.018	-0.055	0.224*
FCW																					1.000	-0.617**	0.496**
TSS																						1.000	-0.315**

*Significant at 5% **Significant at 1%

VL90: Vine length (cm) at 90 DAT NPB: Number of primary branches LA: Leaf area (cm²) per plant DFFF: Days taken for first female flowering

NNFFF: Node number on which first female flower appears D50F: Days to 50% flowering NNFMF: Node at male flower appear DFMF: Days taken for first female flowering SR: Sex ratio FL: Fruit length (cm) FD: Fruit diameter (cm) AFW: Average fruit weight (kg) NFPV: Number of fruits per vine FYPP: Fruit yield per plant (kg) FYPH: Fruit yield per hectare (tons) DFFH: Days to first fruit harvest DLFH: Days to last fruit harvest FT: Flesh thickness (mm) TSW: Total seed weight per fruit (g) NSPF: Number of seeds per fruit (count) FCL: Fruit cavity length (cm) FCW: Fruit cavity width (cm) TSS: Total soluble solids (°Brix)

Conclusion

The correlation analysis revealed that genotypic correlations were generally higher than the corresponding phenotypic correlations, indicating that the associations among traits were predominantly governed by genetic factors with comparatively less environmental influence. Both genotypic and phenotypic correlations showed a similar trend, with fruit diameter, average fruit weight, number of fruits per vine, fruit thickness, fruit length and number of primary branches exhibiting significant positive associations with fruit yield per plant. These traits contribute directly to yield by increasing fruit size, fruit weight and fruit production. In contrast, total soluble solids, days to first fruit harvest and days to last fruit harvest showed negative associations with fruit yield, suggesting a trade-off between yield and quality or maturity traits. Therefore, these positively associated traits can be effectively used as reliable selection criteria for the development of high-yielding ash gourd genotypes in breeding programmes.

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